# ANNUAL REPORT
# SMALL-BODIED FISHES MONITORING
# SAN JUAN RIVER
## Conducted September 2014

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**Santa Fe, New Mexico**

**June 24, 2015**
**San Juan River Basin Recovery Implementation Program**

# ANNUAL REPORT

# SMALL-BODIED FISHES MONITORING
# SAN JUAN RIVER

**to**

**Bureau of Reclamation**

**From**

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**Agreement Number: SJ2631**

**Reporting Dates: 1 October 2013 through 30 September 2014**

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# EXECUTIVE SUMMARY

Small-bodied fish monitoring on the San Juan River in 2014 resulted in the capture of 28 Colorado Pikeminnow *Ptychocheilus lucius*, ranging from 91 - 166 mm total length. Most captures occurred in Reaches 5 and 6, and overall density in 2014 was similar to the 10-year (2004 – 2013) river-wide mean (both 0.002 fish/$m^2$). The low numbers of larval Colorado Pikeminnow observed in 2013 and the large size of fish captured during small-bodied fish monitoring indicate that all captured Colorado Pikeminnow in 2014 were the result of augmentation efforts. Two Roundtail Chub *Gila robusta* were captured in Reach 5 (RM 152), the first captured since 2012. No Razorback Suckers *Xyrauchen texanus* were captured, and as of 2014 no juvenile Razorback Suckers have been documented during small-bodied fish monitoring. River-wide, nonnative fish were observed at the lowest density in the past 10 years. Although native fish density also declined in 2014, the proportion of native fish river-wide was 76%, much higher than the 10-year mean of 53%.

For the third year in a row, additional sampling was conducted in River Ecosystem Restoration Initiative (RERI) restored secondary channels and in areas of the San Juan River upstream of the confluence with the Animas River. Species richness and density of small-bodied fishes in naturally flowing and RERI restored secondary channels appeared similar, but the majority of sites were dry in 2014, limiting the ability to draw any conclusions.

No Colorado Pikeminnow were captured above the confluence with the Animas River. The density and number of nonnative species above and below the Animas River confluence appeared to decrease while native species richness and density remained similar to 2012 and 2013. Including portions of the Animas River in small-bodied fish monitoring may be benfical in the future to assess ongoing rare native fish augmentation efforts.

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# INTRODUCTION

The San Juan River Basin Recovery Implementation Program's (SJRBRIP) Long-Range Plan specifies that fish populations of the San Juan River will be monitored (Element 4; SJRBIP 2014). Task 4.1.2.2 of this plan specifies monitoring of juvenile and small-bodied fishes. The primary objectives of this monitoring are to document occurrence and density of rare species (i.e. Colorado Pikeminnow *Ptychocheilus lucius;* Razorback Sucker *Xyrauchen texanus*; Roundtail Chub *Gila robusta*), particularly age-0 individuals; characterize mesohabitat use of rare species and other small-bodied fishes; and track trends in native and nonnative species' populations. Collected information can then be used to inform the management and recovery of these rare species. Monitoring occurs in autumn to characterize the survival and recruitment of small-bodied and age-0 fishes.

Augmentation of Colorado Pikeminnow and Razorback Sucker, through stocking of hatchery fish, is one of the principal management actions conducted by the SJRBRIP (Element 1; SJRBRIP 2014). Between 1996 and 2001, experimental and opportunistic stocking of Colorado Pikeminnow occurred in the San Juan River resulting in the stocking of approximately 830,000 fish (Furr 2012). In 2002, the U.S. Fish and Wildlife Service implemented a formal stocking program for the species (Ryden 2003). Since then, approximately 3.5 million age-0 Colorado Pikeminnow have been stocked into the San Juan River (Furr 2014). Experimental stocking of Razorback Sucker occurred between 1994 and 1996, resulting in the release of 942 fish. Beginning in 1997, the U.S. Fish and Wildlife Service adopted an official augmentation plan for Razorback Sucker which has resulted in the release of over 130,000 Razorback Sucker (Ryden 1997; Furr 2014).

Since 2002, annual population augmentations in the San Juan River have averaged approximately 298,000 Colorado Pikeminnow and 10,650 Razorback Sucker. Both Colorado Pikeminnow and Razorback sucker have been captured during small-bodied fish monitoring over this

time period, although captures of Razorback Sucker have been more sporadic. Despite the large number of stocked fish and yearly captures of larval Razorback Sucker (Farrington et al. 2014; Furr 2014), recruitment of wild-spawned Colorado Pikeminnow and Razorback Sucker have yet to be documented. Therefore, small-bodied monitoring currently provides information on the survival and distribution of stocked age-0 and age-1+ Colorado Pikeminnow and the native/nonnative fish assemblage.

In 2011, The Nature Conservancy, through a grant from the New Mexico River Ecosystem Restoration Initiative (RERI) and in partnership with the Navajo Nation, US Fish and Wildlife Service, Bureau of Reclamation, and the SJRBRIP, restored channel complexity along portions of the San Juan River by increasing the amount of wetted secondary channel habitat. The project improved six sites, restoring 3.5 miles of secondary channels and 6.5 acres of riparian vegetation along six miles of river using channel sluicing, mechanical clearing and chemical treatment of invasive plant species, inlet re-establishment and cleaning, and excavation of secondary channels. Beginning in 2012, yearly sampling has been conducted in these secondary channels to determine how the fish assemblage at these sites compared to naturally flowing secondary channels.

To expand the range of Colorado Pikeminnow and Razorback Sucker, hatchery stocking of these species occurs in the San Juan River upstream of its confluence with the Animas River as well as in the Animas River (Furr 2014). In 2012, the SJRBRIP expanded adult and small-bodied fish monitoring to reaches of the San Juan River upstream of the Animas River confluence. This is the first time since the mid-1990s that adult and small-bodied fish sampling has been conducted in this portion of the San Juan River by the SJRBRIP. Sampling in these areas is designed to determine if Colorado Pikeminnow and Razorback Sucker augmentation can expand the range of these two species and if potential Colorado Pikeminnow prey occurs in these areas.

# METHODS

## Study-Site and Sampling Methods

Small-bodied fish sampling has occurred throughout much of the San Juan River downstream of the Animas River confluence every year since 1998 (Figure 1; Table 1). In 2012, sampling effort was extended to include additional areas of Reach 6 upstream of the confluence with the Animas River (located at river mile (RM) 180.5). Sampling has continued in this area every year since and river-wide sampling now occurs from Bloomfield, NM (RM 194.4, Reach 7) to Sand Island, UT (RM 76.4, Reach 3; Figure 1). This is an upstream increase in sampling of 13.9 river miles. From 1998-2010, small-bodied monitoring occurred from the San Juan and Animas River's confluence downstream to Clay Hills Crossing, UT (RM 3.0, Reach 1). As of 2011, monitoring only occurs downstream from Sand Island to Clay Hills Crossing every fifth year; the next effort in this reach will be in 2015.

From 1998-1999, a secondary channel was sampled only if it occurred within the 1-mile reach to be sampled at every 3-mile interval (designated mile). This protocol excluded a large proportion of secondary channels (30 to 50%, depending upon the starting point of the designated mile). Beginning in 2000, attempts were made to sample all secondary channels >200 m in length which had surface water.

From 1998-1999, the primary channel was sampled at each sampled secondary channel or designated mile if no secondary channel was present in a 3-mile reach. Since 2000, fishes were collected from primary channel habitats at each designated mile whether or not a secondary channel was present. Small-bodied monitoring occurs in conjunction with sub-adult/adult monitoring and designated miles were coordinated to occur in miles that were not sampled by the sub-adult/adult monitoring crews. All backwaters (>50 $m^2$), regardless of occurrence within a designated mile, were sampled.

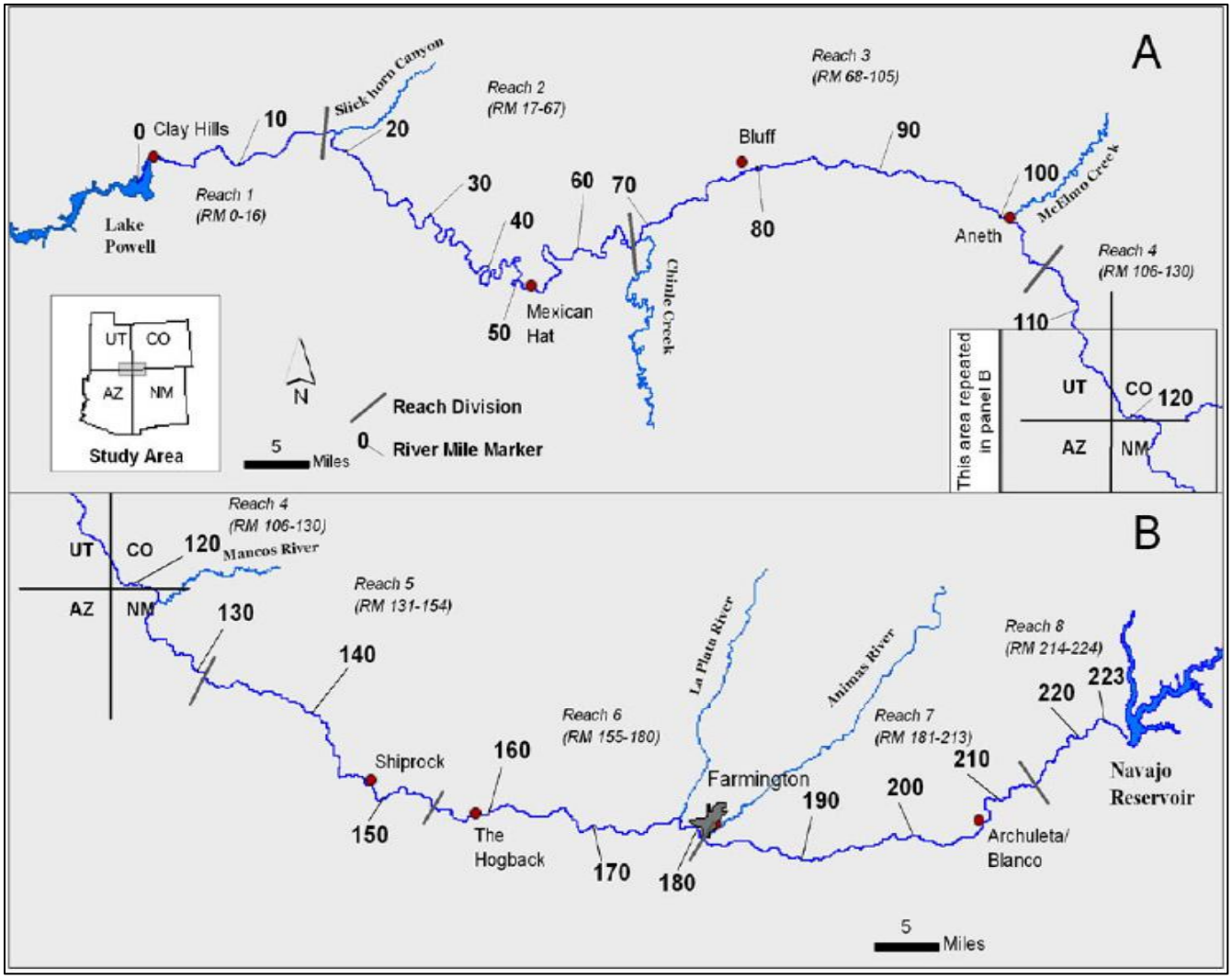


Figure 1. Map of the San Juan River including river miles and geomorphic reaches: (A) river miles 0-120, (B) river miles (120-223).

Primary channel sample sites were about 200 m long (measured along the shoreline). Lengths of secondary channel sample sites varied depending upon extent of surface water but were normally 100-200 m. River mile, geographic coordinates, and water quality (pH, dissolved oxygen, conductivity, and temperature) were recorded for each site. Within each site (primary and secondary channel), all mesohabitats (e.g. riffle, run, pool) were sampled in rough proportion to their surface area within a site (see Bliesner and Lamarra 2000 for full list of mesohabitats and definitions). Beginning in 2003, fish data from each mesohabitat within a site were recorded separately.

Table 1. River mile and geomorphic reaches sampled during small-bodied fish monitoring on the San Juan River, 1998-2014.

| | Extent of River Miles Sampled | Geomorphic Reaches Sampled |
|---|---|---|
| 1998 | 54.0-143.9 | 2-5 |
| 1999 | 4.6-178.5 | 1-6 |
| 2000 | 4.0-165.4 | 1-6 |
| 2001 | 5.05-180.2 | 1-6 |
| 2002 | 4.5-178.7 | 1-6 |
| 2003 | 4.1-178.8 | 1-6 |
| 2004 | 5.6-179.4 | 1-6 |
| 2005 | 6.2-178.6 | 1-6 |
| 2006 | 5.3-177.4 | 1-6 |
| 2007 | 5.8-180.5 | 1-6 |
| 2008 | 4.8-180.6 | 1-6 |
| 2009 | 3.6-178.3 | 1-6 |
| 2010 | 6.9-180.5 | 1-6 |
| 2011 | 78.4-180.4 | 3-6 |
| 2012 | 78.0-194.4 | 3-7 |
| 2013 | 78.4-195.7 | 3-7 |
| 2014 | 78.4-195.7 | 3-7 |

Most primary channel mesohabitats sampled were along stream margins, but offshore riffles and runs (<0.75 m deep) were also sampled. Secondary channel sampling occurred across the breadth of the wetted channel. All available wade-able mesohabitats within a site were sampled. Uncommon mesohabitats (e.g., debris pools and backwaters) were sampled in greater proportion to their availability than common mesohabitats (e.g., runs, riffles, shoals).

All mesohabitat types available at a site were sampled. At least five seine hauls (each seine haul sampling a distinct mesohabitat) were made at each sample site. However, if habitat was homogeneous, as few as three seine hauls in secondary channels were made. Where there was high habitat diversity, as many as 13 seine hauls in the primary channel and eight seine hauls in secondary channels were made. Typically, two seine hauls were made in each backwater, one across its mouth and the second parallel

to the long axis of the backwater. In backwaters that were not large enough to make two seine hauls, one seine haul was made from the mouth, parallel to the long axis of the backwater to the point where water was no longer present.

Fishes were collected with a 2.2 m x 1.9 m x 3.0 mm mesh drag seine. All captured fish were identified to species and enumerated. Total length (TL) of each fish was measured, recorded, and the fish released. In some years, subsamples of >50 individuals of each native fish species, chosen to approximate the proportion of sizes present, were measured for each seine haul; the remainder were counted and released. This procedure was not necessary in 2014. If native fishes were too small to identify they were fixed in 10% formalin and returned to the laboratory. Nonnative fishes were removed from the river after measurements were taken and recorded. If nonnative fishes were found in such abundance that it was not feasible to measure them in the field, they were fixed in 10% formalin and returned to the laboratory. Retained specimens were identified, enumerated, and measured (total and standard length) in the laboratory. Personnel of the University of New Mexico Museum of Southwestern Biology (UNM-MSB), Division of Fishes and personnel from American Southwest Ichthyological Researchers, assisted in verification of fishes identified in the laboratory. All retained specimens were accessioned to the UNM-MSB, Division of Fishes.

Following fish collection, the area (length x width) of each sampled mesohabitat was measured and recorded. For each mesohabitat, habitat type, depth in five generalized locations, and dominant substrate at each depth measurement were recorded. Any cover associated with the habitat was also recorded.

## Data Analysis

Density (fish/$m^2$) of each captured species was calculated for individual mesohabitats (i.e. seine haul). Mean density of captured fish species was then calculated by averaging density from all samples

(i.e. individual mesohabitats). Standard error of density estimates were then calculated as the standard deviation of mean reach density divided by the square root of the number of mesohabitats sampled. Catch per unit effort (CPUE) and density are used interchangeably in this report. Daily mean discharge (cubic feet/second; cfs) data were obtained from the U.S. Geological Survey stream gage at Shiprock, New Mexico (Gage 09368000; data available: http://waterdata.usgs.gov/nm/nwis/uv?site_no=09368000) and used to calculate several discharge attributes for spring (1 March – 30 June) and summer (1 July – 30 September) periods.

Alpha values of $< 0.10$ were considered significant due to the natural variability of age-0 fish (Brown and Guy 2007); except an alpha value of 0.05 was used when assessing normality (Shapiro-Wilk test) and homogeneity of variance (Bartlett's test). Density data that did not meet the assumptions of normality were log+0.001 transformed and re-tested. Non-parametric tests were used if data failed to meet assumptions. Due to limited data for RERI sites detailed statistical analyses were not conducted for this data. However, information and observations from these sampling efforts are included below. All statistical tests were conducted with R 3.2.0.

# RESULTS

## Discharge Data

San Juan River discharge at Shiprock, NM in 2014 was lower than the 10-year (2004 – 2013) mean discharge throughout much of the year (Figure 1). Spring discharge peaked at 4050 cfs and remained above 3000 cfs for only 11 days. This was the lowest number of days above 3000 cfs at the Shiprock gage in the previous ten years except for 2013. Average spring discharge was also the lowest observed in the past 10 years with the exception of 2013 (Appendix I). Summer discharge was also very low with 75 days below 1,000 cfs, the second highest since 2004, and above the 10-year mean of

65. The mean summer discharge of the San Juan River at Shiprock, NM was 798 cfs, almost 200 cfs below the 10-year average (Appendix I).

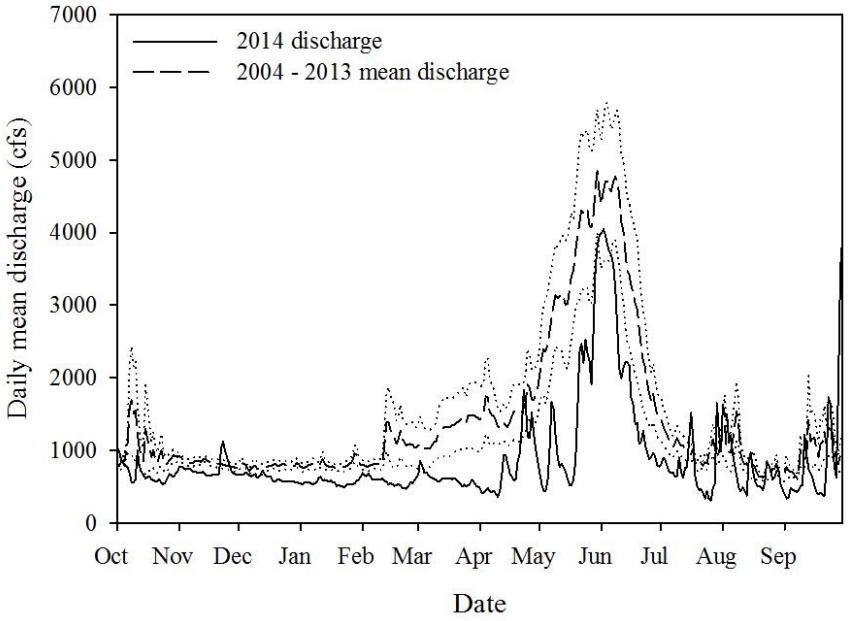


Figure 2. Ten-year mean and 2014 mean daily discharge (cubic feet/second; cfs) of the San Juan River at Shiprock, NM (USGS gage 09368000). Dotted lines indicate ± 1 SE for 2004 – 2013.

## River-wide Summary

The total number (N = 2208) of small-bodied fish captured river-wide in 2014 was lower than the 10-year (2004 – 2013) mean. Approximately 76% of all fish captured were native species (Figure 2), although the amount captured (N = 1680) was less than the 10-year mean (Table 2). Since 2004, the proportion of captured fish that are native species has significantly increased (simple-linear regression, $R^2 = 0.30$, $P = 0.0480$). The number of nonnative small-bodied fish captured in 2014 (N = 528) was lower than the 10-year mean, and the fewest number captured during that time period (Table 2). A total of 27 Colorado Pikeminnow were captured during sampling, similar to the 10-year mean of 26. No

Razorback Sucker was captured during small-bodied fish monitoring in 2014. Two Roundtail Chub *Gila robusta* were captured in 2014, the first captured during small-bodied fish monitoring since 2012. No evidence of disease, deformities, or hybridization was observed in fishes collected in 2014.

River-wide mean density (0.197 fish/$m^2$, SE = 0.044) was also the lowest observed in the previous 10-years (Wilcoxon test, $P = 0.001$; Table 2). Mean density of native fish (Mean = 0.123 fish/$m^2$, SE = 0.027) and nonnative fish (Mean = 0.066 fish/$m^2$; SE = 0.032) in 2014 were both also lower than their 10-year mean. Mean density of Colorado Pikeminnow (0.002 fish/$m^2$, SE = 0.001) was similar to the ten-year mean (t-test, $P > 0.10$; Table 2).

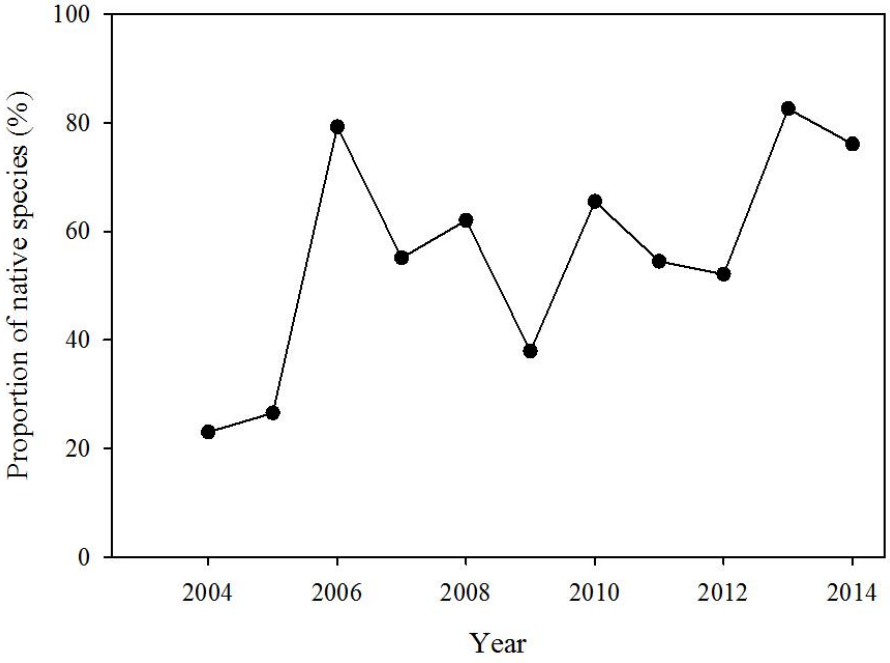


Figure 3. Proportion of all fish captured during San Juan River small-bodied fish monitoring that were native species, 2004 – 2014.

Table 2. Summary of river-wide small-bodied fish monitoring captures and densities (fish/$m^2$) in the San Juan River during 2014 and the previous 10-year (2004 – 2013) means.

| | Number captured | | | Density (fish/$m^2$) | | | | |
|---|---|---|---|---|---|---|---|---|
| | **2014** | **2004-2013 Mean** | **2004-2013 Range** | **2014** | **SE** | **2004-2013 Mean** | **SE** | **2004-2013 Range** |
| Total Fishes | 2208 | 8257 | 3795-29750 | 0.197 | 0.044 | 1.054 | 0.333 | 0.358-3.691 |
| Native Fishes | 1680 | 3510 | 1846-6845 | 0.123 | 0.027 | 0.401 | 0.063 | 0.107-0.846 |
| Non-native Fishes | 528 | 4744 | 787-22904 | 0.066 | 0.032 | 0.748 | 0.296 | 0.132-3.021 |
| Colorado Pikeminnow | 27 | 26 | 3-62 | 0.002 | 0.001 | 0.002 | 0.001 | 0.002-0.007 |
| Razorback Sucker | 0 | 0 | 0-1 | 0 | 0 | 0 | 0 | 0 |
| Roundtail Chub | 2 | 0 | 0-2 | 0.0001 | 0.0001 | 0 | 0 | 0 |

## Colorado Pikeminnow Summary Statistics and Distribution

A total of 27 Colorado Pikeminnow were captured in 2014, similar to the 10-year (2004-2013) mean number of captures (Table 2; Figure 3). The river-wide mean density of Colorado Pikeminnow was 0.002 fish/$m^2$ (SE = 0.001) and was similar to the 10-year mean river-wide density. Similar to other years, the density (fish/$m^2$) of Colorado Pikeminnow varied by river mile and channel type (i.e. primary, secondary, and backwater). The greatest densities and number of captures of Colorado Pikeminnow occurred in RM 155-180 (Reach 6) followed by RM 131-154 (Figure 5; Appendix VI), but density was not significantly different between sampled reaches (Kruskal-Wallis, $P > 0.05$). Few fish were captured in between RM 68 and 130 (Reach 3 and 4) and no sampling occurred from RM 0 to 67 (Reach 1 and 2) in 2014. Density of small-bodied Colorado Pikeminnow was similar between primary and secondary channels (Wilcox test, $P > 0.05$), although more captures occurred in primary channels (Appendix III and IV).

Captured Colorado Pikeminnow ranged from 91-166 mm TL and averaged 133 mm TL in 2014 Table 3). The average mean length for 2014 was the smallest since 2007. No young-of-year Colorado Pikeminnow were captured in 2014. No captured Colorado Pikeminnow were tagged individuals and only 3 individuals were large enough to be tagged.

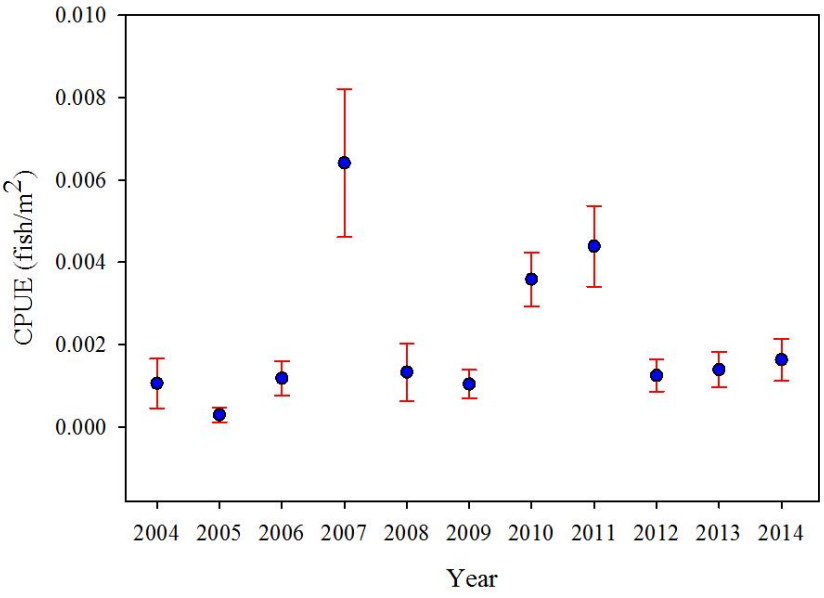


Figure 4. River-wide mean Colorado Pikeminnow CPUE (fish/$m^2$) in the San Juan River captured during small-bodied fish monitoring, 2004 - 2014. Bars indicate ± 1 SE.

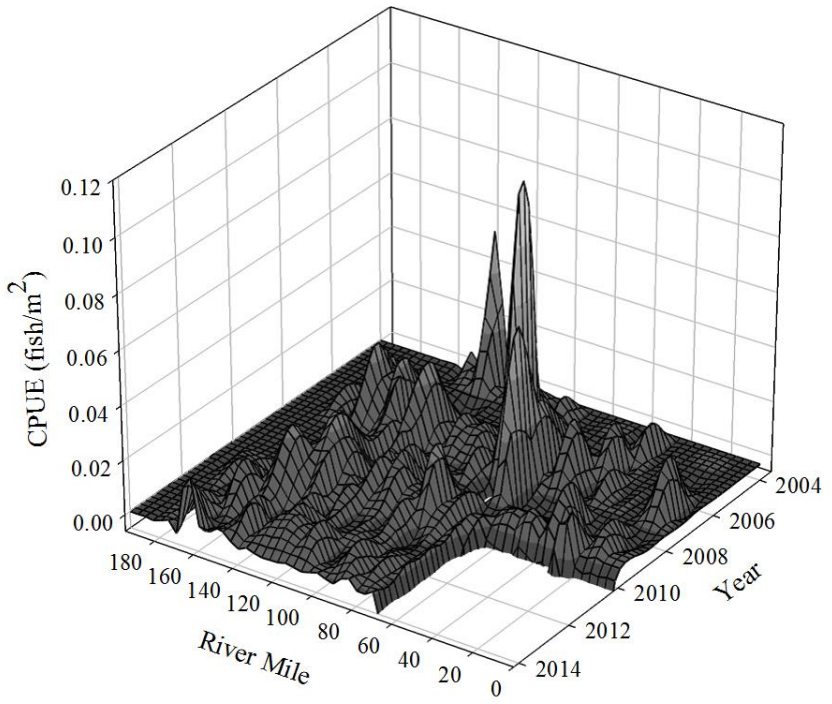


Figure 5. River-wide distribution of Colorado Pikeminnow CPUE (fish/m2) in the San Juan River, 2004 – 2014. Note that RM 0 – 67 have not been sampled since 2010.

Table 3. Annual Colorado Pikeminnow captures in the San Juan River during small bodied fish monitoring and summary information on captured fish total lengths (TL), 2004 - 2014.

| Year | Total Captures | Mean TL | +/- 1 SE TL | Median TL | Minimum TL | Maximum TL | Range TL |
|---|---|---|---|---|---|---|---|
| 2004 | 8 | 187.63 | 8.90 | 181.00 | 160 | 233 | 73 |
| 2005 | 3 | 211.33 | 39.01 | 179.00 | 166 | 289 | 123 |
| 2006 | 10 | 180.00 | 13.12 | 176.50 | 136 | 276 | 140 |
| 2007 | 60 | 101.53 | 6.99 | 120.00 | 39 | 183 | 144 |
| 2008 | 10 | 152.40 | 7.07 | 149.00 | 131 | 210 | 79 |
| 2009 | 12 | 184.17 | 14.85 | 174.50 | 122 | 328 | 206 |
| 2010 | 49 | 162.20 | 4.33 | 155.00 | 118 | 256 | 138 |
| 2011 | 62 | 147.87 | 6.07 | 137.50 | 96 | 362 | 266 |
| 2012 | 26 | 158.62 | 5.08 | 155.50 | 115 | 203 | 88 |
| 2013 | 16 | 216.20 | 10.27 | 211.00 | 143 | 294 | 151 |
| 2014 | 28 | 133.00 | 3.63 | 134.5 | 91 | 166 | 75 |

## River Ecosystem Restoration Initiative Secondary Channels

Both RERI secondary channels and reference secondary channels were sampled on 19 September 2014. Only two of six RERI secondary channels were sampled in 2014 because sites at RM 132, 130.7A, 128.6, and 127.2 were dry (Figure 6; Table 4). Two reference secondary channels, located at RM 134.3 and 130.1, were sampled in 2014. The high number of dry RERI and reference secondary channels in 2014 was likely due to the relatively low flow (484 cfs) that occurred during sampling (Figure 7).

Statistical comparisons between RERI and reference sites were not made because fish were captured at only one RERI site (RM 132.2) and one reference site (RM 134.3) during 2014 sampling. No Colorado Pikeminnow was captured in either RERI site after captures had occurred in both 2012 and 2013 at RERI sites (Figure 8). Native and nonnative fish were captured at both reference and RERI sites. Nonnative Channel Catfish were only captured in RERI sites (Figure 8). The number of species observed in 2014 was much lower than in 2012 and 2013. Mosquitofish and Fathead Minnow were not observed in either reference or RERI sites after having been observed the previous two years (Figure 7).


Figure 6. Location of RERI (circles) and reference (triangles) sampling sites on the San Juan River where small-bodied fish monitoring occurs.

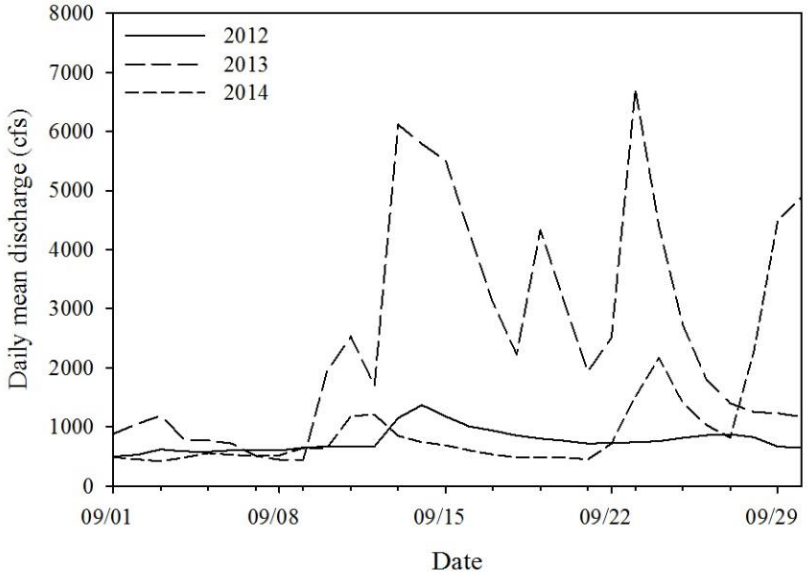


Figure 7. Daily discharge (cubic feet/second; cfs) in the San Juan River at Four Corners, CO during small-bodied fish monitoring in September 2012, 2013, and 2014.

Table 4. Locations and sampling information for River Ecosystem Restoration Initiative (RERI) and reference secondary channel sampling sites on the San Juan River, 2012 - 2014.

| Site Type | River Mile | 2012 | Notes | 2013 | Notes | 2014 | Notes |
|---|---|---|---|---|---|---|---|
| Reference | 134.3 | Sampled | | Not Sampled | Flow greater than definition of secondary channel | Sampled | |
| Reference | 133.5 | Sampled | | Not Sampled | Flow greater than definition of secondary channel | Dry | |
| RERI | 132.2 | Sampled | | Sampled | | Sampled | |
| RERI | 132 | Not Sampled | Dry | Sampled | | Dry | |
| Reference | 130.1 | Sampled | | Sampled | | Sampled | No Fish Captured |
| RERI | 130.7A | Sampled | | Sampled | | Dry | |
| RERI | 130.7B | Sampled | | Not Sampled | Flow too fast for safe sampling | Sampled | No Fish Captured |
| RERI | 128.6 | Not Sampled | Not Located | Not Sampled | Not located | Dry | |
| RERI | 127.2 | Sampled | | Sampled | | Dry | |
| Reference | 122.7 | Sampled | | Sampled | | Dry | |

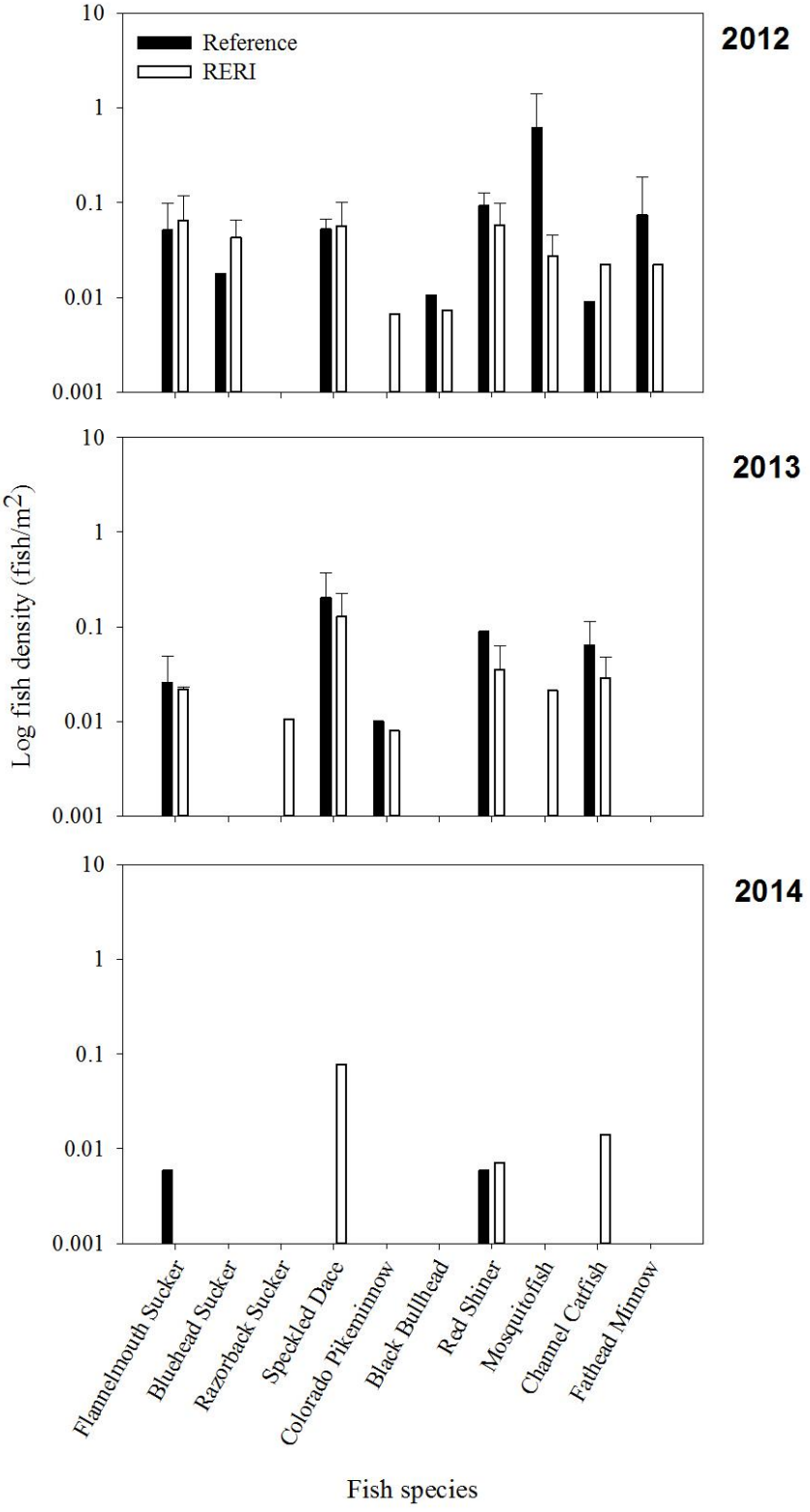


Figure 8. Fish density (fish/$m^2$) at RERI and reference secondary channel sampling sites on the San Juan River from 2012 – 2014. Bars indicate + 1 SE.

## San Juan River Upstream of San Juan- Animas Confluence

Comparable sampling effort was expended between the 13.9 miles upstream and downstream of the Animas River confluence during 2014 small-bodied fish monitoring in the San Juan River. Similar to previous years, six sites were sampled upstream of the Animas River confluence and eight sites were sampled downstream of the confluence. In 2014, less fish species were observed both upstream and downstream of the Animas River confluence in comparison to sampling in 2012 and 2013 (Figure 9). The majority of species not observed in 2014 were nonnative species, and some nonnative species that were observed appeared to be greatly reduced in number compared to 2012 and 2013. Native Flannelmouth Sucker *Catostomus latipinnis*, Bluehead Sucker *Catostomus discobolus*, and Speckled Dace *Rhinichthys osculus* had comparable densities upstream and downstream of the confluence (t-test, $P > 0.10$). There was also no significant difference between the densities of nonnative Fathead Minnows *Pimephales promelas* upstream and downstream of the confluence (t-test, $P > 0.10$). Comparisons between upstream and downstream densities were not made for other fish species captured because most were caught from either only one or two sites, or captured only upstream or downstream of the Animas River confluence. A single Colorado Pikeminnow was captured downstream of the Animas River confluence and no Mottled Sculpin *Cottus bairdii* were captured upstream or downstream of the confluence. Colorado Pikeminnow and Mottled Sculpin were also rare in this section during 2012 and 2013 sampling.

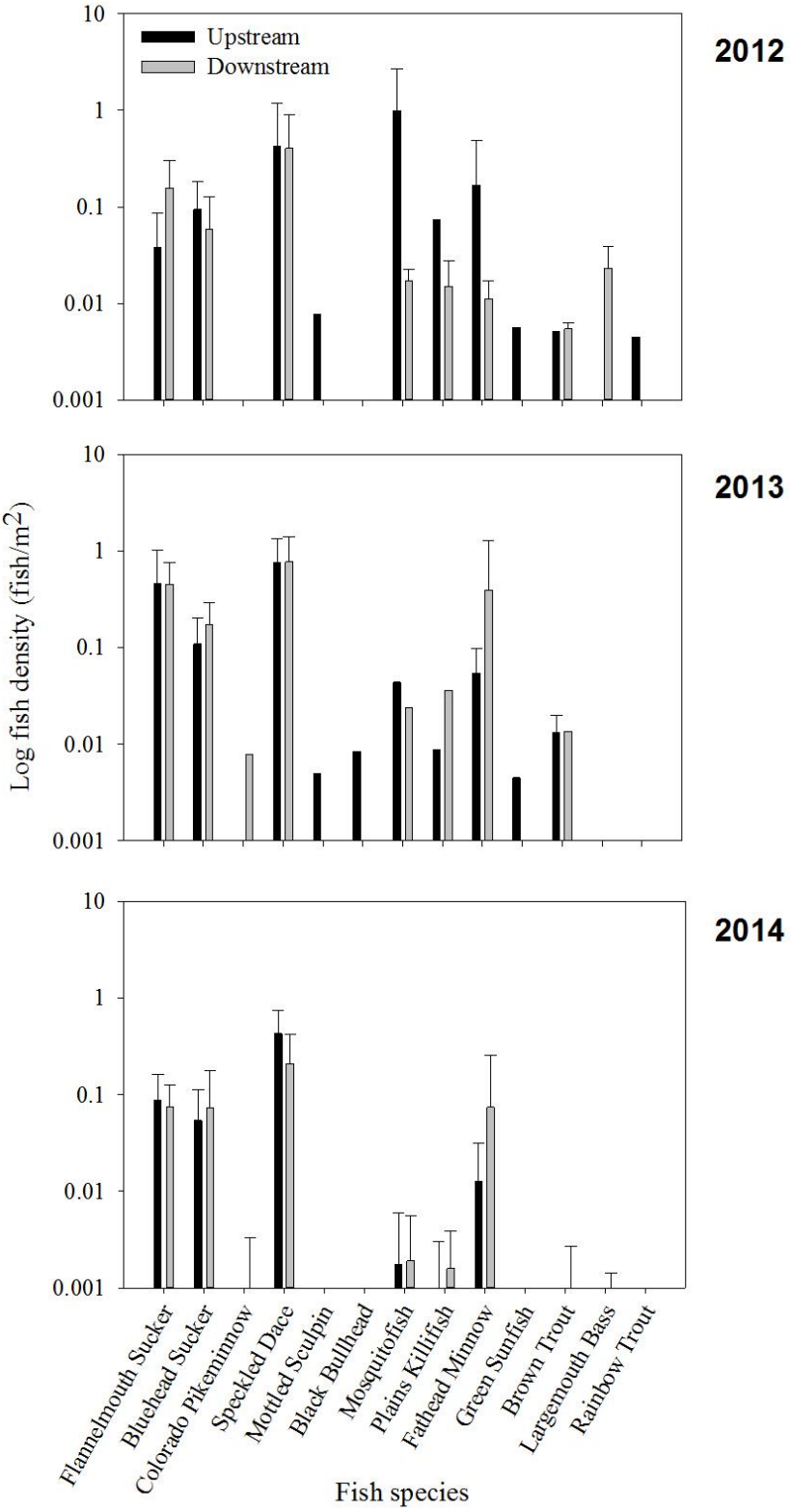


Figure 9. Fish density (fish/$m^2$) in the San Juan River upstream and downstream of the confluence with the Animas River from 2012 – 2014. Bars indicate +1 SE.

# DISCUSSION

Monitoring of fish populations in the San Juan River is an important part of the SJBRIP's long-term plans. Data collected during yearly monitoring is then used to evaluate management actions and assess the status of native species. An important component of this is the monitoring of small-bodied fish (SJRBIP 2014; Element 4, Task 4.12.2). Capture and identification of small-bodied native fish is used to determine if survival and recruitment of young fish is occurring and to locate areas and habitats used for rearing by Colorado Pikeminnow and Razorback Sucker (SJRBRIP 2012). In recent years the SJRBRIP has undertaken several management actions including: 1) augmentation of Colorado Pikeminnow and Razorback Sucker in the upper reaches of the San Juan River, 2) support of the River Ecosystem Restoration Initiative, and 3) assessment of an experimental small-bodied fish sampling technique. This report provides a summary of the populations of small-bodied fishes in the San Juan River to inform these management actions and the recovery progress of Colorado Pikeminnow and Razorback Sucker.

The number and density of captured native and nonnative fish in 2014 were lower than the 10-year means and nonnative fish were at the lowest densities observed in the past 10 years. The low number of native captures may have been driven by very low captures of Speckled Dace in comparison to other years. Colorado Pikeminnow was captured for the 11$^{th}$ consecutive year during small-bodied fish monitoring. The density of Colorado Pikeminnow was similar to previous years but did vary throughout the river with the majority of fish being captured in Reaches 5 and 6. Although larval Razorback Sucker continued to be captured each year (Farrington et al. 2014), no wild juvenile fish were captured during small-bodied fish monitoring in 2014 or any other years during small-bodied or sub-adult and adult monitoring efforts (Schleicher 2014). Two Roundtail Chub were captured, the first since 2012.

Only two RERI secondary channels and two reference secondary channels were sampled during 2014 because the remaining sites were dry. Fish were only captured in one of each channel type (i.e. RERI or reference) sampled. Fewer species of native and nonnative fish were captured in RERI and reference secondary channels in 2014 than in the previous 2 years. No Colorado Pikeminnow was captured at a RERI site for the first time since sampling began. Although the RERI site at RM 132.2 had the lowest species richness in each of the past 3-years, the reference site in 2014 also had very low species richness. The low species richness observed and the high number of dry RERI and reference secondary channels was likely due to the very low flows which occurred during sampling. Differences in flows between 2012, 2013, and 2014 make it difficult to determine differences in habitat conditions among RERI sites and between reference sites. The RERI sites, and reference secondary channels, will continue to be sampled during annual small-bodied fish monitoring. Additional data will aide in the comparison of natural and mechanically restored side channels.

The assemblage and density of fish was similar in reaches of the San Juan River upstream and downstream of the Animas River confluence, except that Colorado Pikeminnow were captured only downstream of the confluence. Mottled Sculpin have only been observed upstream of the confluence, but none were captured in 2014. Although the density and assemblage of native fish in 2014 was comparable to the previous 2 years, the density and number of nonnative species observed was much lower. For instance, Brown Trout *Salmo trutta* were not observed upstream in 2014 but were in 2012 and 2013. Mosquitofish *Gambusia affinis* and Plains Killifish *Fundulus zebrinus* both had decreased densities upstream and downstream of the Animas River confluence in comparison to 2012 and 2013. Similar densities of prey species located above and below the Animas River confluence indicates that San Juan River above the Animas River could be use at least seasonally by Colorado Pikeminnow. The

cold water temperatures, as mediated by releases from Navajo Dam, likely limit the usability of habitat above the Animas River confluence by Colorado Pikeminnow (Lamarra 2007).

## Conclusion

Although captures of Colorado Pikeminnow have remained fairly consistent over the previous 10 years, Roundtail Chub have only been captured sporadically and no Razorback Sucker have been captured during small-bodied fish monitoring. The historic pattern continued in 2014 with the density of Colorado Pikeminnow remaining similar to the 10-year mean. No Razorback Sucker was captured during small-bodied fish sampling in 2014 and to date no juveniles have ever been captured. Roundtail Chub were captured for the first time since 2012 and only the third time in the previous 10-years.

Nonnative small-bodied fish captures were the lowest in the previous 10-years and some species were not detected at sites where they previously had been. The very low discharges observed in 2014 may have been a significant factor in the decrease of both native and nonnative fish river-wide. No Colorado Pikeminnow were captured upstream of the Animas River confluence. Sampling above the Animas River confluence should continue for the time being to determine if yearly changes in environmental conditions influence the species assemblage in this part of the river and because of continued rare native fish stockings in the area (Furr 2013). Small-bodied fish sampling of the Animas River should be made a priority to assess the current fish assemblage and determine presence of rare native fish.

Secondary channels constructed or rehabilitated though The Nature Conservancy's efforts (RERI) appear to perform similar to naturally present secondary channels based on captures of small-bodied fish. Small-bodied fish sampling in these restored channels will continue per standardized protocol which requires all secondary channels to be sampled.

## ACKNOWLEDGEMENTS

This work was funded under a grant from the U.S. Bureau of Reclamation. John Caldwell, Eliza Gilbert, Andrew Monie (New Mexico Department of Game and Fish), Nathan Franssen (University of New Mexico) provided assistance in the field. This draft report was reviewed and edited by Kirk Patten (New Mexico Department of Game and Fish).

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# APPENDICES

Appendix I. Mean daily discharge (cubic feet/second; cfs) and discharge attributes of the San Juan River at Shiprock, NM (USGS Gage 09368000) during spring runoff and summer months, 2004 -201

| Spring Attributes | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2004-2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| March Mean | 1043 | 1278 | 537 | 1276 | 4483 | 940 | 934 | 788 | 947 | 565 | 604 | 1279 |
| April Mean | 1829 | 3026 | 760 | 1244 | 3789 | 987 | 1177 | 692 | 1313 | 616 | 806 | 1543 |
| May Mean | 2406 | 7983 | 2284 | 6050 | 4780 | 4163 | 1902 | 1167 | 2504 | 1301 | 1507 | 3454 |
| June Mean | 1836 | 6380 | 3142 | 3250 | 7450 | 2978 | 1708 | 4710 | 842 | 644 | 2082 | 3294 |
| Spring Mean | 1778 | 4666 | 1676 | 2967 | 5117 | 2272 | 1430 | 1825 | 1407 | 784 | 1246 | 2392 |
| Days Q>3,000 | 14 | 76 | 23 | 48 | 102 | 37 | 10 | 21 | 11 | 0 | 11 | 34 |
| Days Q>5,000 | 0 | 50 | 9 | 21 | 47 | 20 | 0 | 11 | 7 | 0 | 0 | 17 |
| Days Q>8,000 | 0 | 18 | 0 | 5 | 22 | 0 | 0 | 7 | 0 | 0 | 0 | 5 |
| Days Q>10,000 | 0 | 11 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

| Summer Attributes | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2004-2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July Mean | 585 | 1461 | 967 | 1054 | 1463 | 816 | 833 | 1497 | 884 | 699 | 747 | 1026 |
| August Mean | 398 | 966 | 1196 | 1518 | 740 | 536 | 1202 | 628 | 625 | 909 | 749 | 872 |
| Sept Mean | 1120 | 684 | 904 | 1178 | 787 | 464 | 817 | 814 | 784 | 2147 | 903 | 970 |
| Summer Mean | 696 | 1041 | 1024 | 1251 | 999 | 607 | 952 | 981 | 764 | 1242 | 798 | 956 |
| Days Q>5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Days Q>4,000 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 5 | 0 | 1 |
| Days Q>3,000 | 1 | 1 | 2 | 6 | 0 | 0 | 1 | 0 | 0 | 8 | 2 | 2 |
| Days Q>2,000 | 6 | 6 | 5 | 9 | 5 | 0 | 4 | 6 | 0 | 13 | 2 | 5 |
| Days Q>1,000 | 11 | 41 | 33 | 41 | 37 | 4 | 20 | 32 | 13 | 33 | 17 | 27 |
| Days Q<1,000 | 80 | 50 | 59 | 51 | 55 | 87 | 72 | 60 | 78 | 59 | 75 | 65 |
| Days Q<750 | 70 | 40 | 36 | 13 | 41 | 79 | 41 | 48 | 58 | 42 | 58 | 47 |
| Days Q<500 | 49 | 17 | 0 | 0 | 11 | 29 | 1 | 10 | 6 | 12 | 28 | 14 |

Appendix II. Six letter species abbreviations, common names, and scientific names of fishes captured during small-bodied fish monitoring in the San Juan River.

| Scientific Name | Common Name | Six Letter Species Code Abbreviation | Native Species |
|---|---|---|---|
| *Catostomus discobolus* | Bluehead Sucker | CATDIS | Native |
| *Catostomus latipinnis* | Flannelmouth Sucker | CATLAT | Native |
| *Cottus bairdii* | Mottled Sculpin | COTBAI | Native |
| *Gila robusta* | Roundtail Chub | GILROB | Native |
| *Ptychocheilus lucius* | Colorado Pikeminnow | PTYLUC | Native |
| *Rhinichthys osculus* | Speckled Dace | RHIOSC | Native |
| *Xyrauchen texanus* | Razorback Sucker | XYRTEX | Native |
| *Ameiurus melas* | Black Bullhead | AMEMEL | No |
| *Ameiurus natalis* | Yellow Bullhead | AMENAT | No |
| *Cyprinus carpio* | Common Carp | CYPCAR | No |
| *Cyprinella lutrensis* | Red Shiner | CYPLUT | No |
| *Fundulus zebrinus* | Plains Killifish | FUNZEB | No |
| *Gambusia affinis* | Mosquitofish | GAMAFF | No |
| *Ictalurus punctatus* | Channel Catfish | ICTPUN | No |
| *Lepomis cyanellus* | Green Sunfish | LEPCYA | No |
| *Lepomis macrochirus* | Bluegill | LEPMAC | No |
| *Micropterus salmoides* | Largemouth Bass | MICSAL | No |
| *Oncorhynchus mykiss* | Rainbow Trout | ONCMYK | No |
| *Pimephales promelas* | Fathead Minnow | PIMPRO | No |
| *Salmoides trutta* | Brown Trout | SALTRU | No |

Appendix III. Number, mean CPUE (fish/$m^2$), and SE of fishes collected in primary channel samples during small-bodied fish monitoring in the San Juan River, 2003 – 2014.

| | 2003 | | | 2004 | | | 2005 | | | 2006 | | | 2007 | | | 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE |
| AMEMEL | | | | 2 | 0.0005 | 0.0004 | 1 | 0.0006 | 0.0006 | 3 | 0.0004 | 0.0004 | | | | 1 | 0.0005 | 0.0005 |
| AMENAT | | | | | | | | | | | | | | | | | | |
| CATDIS | 27 | 0.0068 | 0.0021 | 283 | 0.0463 | 0.0056 | 90 | 0.0267 | 0.016 | 154 | 0.0404 | 0.0229 | 53 | 0.0066 | 0.0017 | 58 | 0.0158 | 0.0098 |
| CATLAT | 140 | 0.0622 | 0.0231 | 255 | 0.0441 | 0.0072 | 111 | 0.0289 | 0.0131 | 62 | 0.012 | 0.0028 | 227 | 0.0221 | 0.0073 | 101 | 0.0117 | 0.0039 |
| CYPCAR | | | | 6 | 0.0012 | 0.0006 | 3 | 0.0005 | 0.0004 | | | | | | | 2 | 0.0006 | 0.0004 |
| CYPLUT | 1706 | 0.5243 | 0.0801 | 9830 | 1.8335 | 0.3551 | 2521 | 0.8478 | 0.2573 | 164 | 0.0357 | 0.0061 | 204 | 0.031 | 0.0072 | 190 | 0.0314 | 0.0084 |
| FUNZEB | 21 | 0.0056 | 0.0028 | 30 | 0.0051 | 0.0034 | 1 | 0.0003 | 0.0003 | | | | | | | 2 | 0.0001 | 0.0001 |
| GAMAFF | 37 | 0.0093 | 0.0059 | 127 | 0.0239 | 0.0075 | 16 | 0.0067 | 0.0035 | 4 | 0.0009 | 0.0007 | 8 | 0.0012 | 0.0009 | 5 | 0.0034 | 0.0028 |
| ICTPUN | 366 | 0.0912 | 0.0144 | 603 | 0.0887 | 0.0161 | 401 | 0.096 | 0.0245 | 336 | 0.0695 | 0.009 | 697 | 0.0835 | 0.0109 | 533 | 0.0718 | 0.0096 |
| LATxDIS | 1 | 0.0002 | 0.0002 | | | | | | | | | | | | | | | |
| LEPCYA | 2 | 0.0004 | 0.0003 | 1 | 0.0004 | 0.0004 | 1 | 0.0003 | 0.0003 | | | | | | | 1 | 0.0001 | 0.0001 |
| MICSAL | | | | 4 | 0.0009 | 0.0005 | | | | | | | 1 | 0.0004 | 0.0004 | | | |
| PIMPRO | 90 | 0.0353 | 0.0137 | 1119 | 0.2416 | 0.0749 | 281 | 0.092 | 0.0322 | 44 | 0.0058 | 0.0049 | 32 | 0.0043 | 0.0026 | 24 | 0.0053 | 0.0036 |
| PTYLUC | | | | 4 | 0.0005 | 0.0002 | 2 | 0.0003 | 0.0002 | 8 | 0.0013 | 0.0005 | 23 | 0.0031 | 0.001 | 3 | 0.0004 | 0.0002 |
| RHIOSC | 511 | 0.1655 | 0.0292 | 4690 | 0.7643 | 0.1026 | 1234 | 0.2689 | 0.0412 | 2401 | 0.7378 | 0.488 | 2177 | 0.2653 | 0.0377 | 1192 | 0.2007 | 0.0244 |
| SALTRU | | | | | | | | | | | | | | | | | | |
| XYRTEX | | | | | | | 1 | 0.0003 | 0.0003 | | | | | | | | | |
| Total N | 2913 | | | 17042 | | | 4639 | | | 3175 | | | 2766 | | | 2217 | | |
| Total Area | 3994 | | | 7768 | | | 5985 | | | 5446 | | | 9038 | | | 7469 | | |
| Density | 0.73 | | | 2.19 | | | 0.78 | | | 0.58 | | | 0.31 | | | 0.36 | | |

| | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE |
| AMEMEL | | | | | | | 4 | 0.0005 | 0.0004 | | | | | | | | | |
| AMENAT | | | | 4 | 0.0008 | 0.0006 | | | | | | | | | | | | |
| CATDIS | 245 | 0.0289 | 0.0069 | 201 | 0.0218 | 0.0061 | 33 | 0.0059 | 0.0022 | 145 | 0.0102 | 0.0033 | 142 | 0.0232 | 0.0105 | 118 | 0.0060 | 0.0369 |
| CATLAT | 216 | 0.0249 | 0.0078 | 594 | 0.0624 | 0.0189 | 104 | 0.0111 | 0.0021 | 276 | 0.0179 | 0.0046 | 370 | 0.0607 | 0.0278 | 201 | 0.0244 | 0.0080 |
| CYPCAR | 1 | 0.0001 | 0.0001 | | | | | | | | | | 1 | 0.0004 | 0.0004 | 1 | 0.0001 | 0.0000 |
| CYPLUT | 2568 | 0.3993 | 0.0862 | 218 | 0.0208 | 0.0043 | 250 | 0.0400 | 0.0086 | 412 | 0.0236 | 0.0732 | 38 | 0.0061 | 0.0025 | 63 | 0.0056 | 0.0026 |
| FUNZEB | 13 | 0.0009 | 0.0009 | 3 | 0.0002 | 0.0002 | 2 | 0.0006 | 0.0004 | 18 | 0.0010 | 0.0005 | 5 | 0.0007 | 0.0005 | 5 | 0.0005 | 0.0002 |
| GAMAFF | 39 | 0.0061 | 0.003 | 3 | 0.0004 | 0.0003 | 44 | 0.0093 | 0.0049 | 145 | 0.0080 | 0.0025 | 16 | 0.0026 | 0.0015 | 9 | 0.0008 | 0.0003 |
| ICTPUN | 122 | 0.0208 | 0.0069 | 460 | 0.0563 | 0.0091 | 493 | 0.0622 | 0.0097 | 105 | 0.0062 | 0.0017 | 249 | 0.0410 | 0.0108 | 73 | 0.0071 | 0.0021 |
| LATxDIS | | | | | | | | | | | | | | | | | | |
| LEPCYA | 7 | 0.0009 | 0.0004 | 1 | 0.0001 | 0.0001 | 2 | 0.0003 | 0.0002 | 2 | 0.0002 | 0.0002 | 1 | 0.0002 | 0.0002 | | | |
| MICSAL | 4 | 0.0007 | 0.0004 | | | | 1 | 0.0010 | 0.0006 | 3 | 0.0002 | 0.0002 | | | | 1 | 0.0010 | 0.0001 |
| PIMPRO | 62 | 0.0088 | 0.0051 | 12 | 0.0014 | 0.0008 | 3 | 0.0004 | 0.0002 | 33 | 0.0016 | 0.0006 | 26 | 0.0050 | 0.0032 | 53 | 0.0052 | 0.0021 |
| PTYLUC | 10 | 0.0013 | 0.0005 | 28 | 0.0029 | 0.0008 | 38 | 0.0029 | 0.0007 | 24 | 0.0018 | 0.0006 | 10 | 0.0016 | 0.0007 | 19 | 0.0019 | 0.0001 |
| RHIOSC | 2964 | 0.4338 | 0.0609 | 2007 | 0.2105 | 0.0329 | 658 | 0.1033 | 0.0176 | 1485 | 0.1259 | 0.0554 | 1354 | 0.2459 | 0.0565 | 860 | 0.1145 | 0.0340 |
| SALTRU | 1 | 0.0001 | 0.0001 | 2 | 0.0001 | 0.0001 | | | | 2 | 0.0002 | 0.0001 | 2 | 0.0005 | 0.0005 | 1 | 0.0001 | 0.0001 |
| XYRTEX | | | | | | | | | | | | | | | | | | |
| Total N | 6252 | | | 3533 | | | 1632 | | | 2653 | | | 2214 | | | 1404 | | |
| Total Area | 8483 | | | 11292 | | | 10160 | | | 16250 | | | 6631 | | | 9753 | | |
| Density | 0.74 | | | 0.31 | | | 0.29 | | | 0.16 | | | 0.33 | | | 0.14 | | |

Appendix IIIV. Number, mean CPUE (fish/$m^2$), and SE of fishes collected in secondary channel samples during small-bodied fish monitoring in the San Juan River, 2003 – 2014.

| | 2003 | | | 2004 | | | 2005 | | | 2006 | | | 2007 | | | 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE |
| AMEMEL | 9 | 0.0057 | 0.0024 | 6 | 0.005 | 0.0031 | 3 | 0.0045 | 0.0031 | 4 | 0.0049 | 0.003 | | | | 3 | 0.0018 | 0.0013 |
| AMENAT | | | | | | | 1 | 0.001 | 0.001 | | | | | | | 3 | 0.0017 | 0.0011 |
| CATDIS | 24 | 0.0167 | 0.0082 | 123 | 0.0827 | 0.0259 | 7 | 0.0064 | 0.0033 | 62 | 0.0256 | 0.0134 | 13 | 0.0057 | 0.0024 | 87 | 0.0202 | 0.0115 |
| CATLAT | 145 | 0.1103 | 0.0531 | 124 | 0.0899 | 0.0293 | 25 | 0.0278 | 0.0099 | 61 | 0.0296 | 0.0131 | 87 | 0.041 | 0.0205 | 195 | 0.0602 | 0.0295 |
| CYPCAR | 2 | 0.0016 | 0.0011 | 10 | 0.0088 | 0.004 | | | | | | | | | | 5 | 0.0029 | 0.0015 |
| CYPLUT | 1636 | 1.6186 | 0.4463 | 7171 | 4.2304 | 0.6358 | 921 | 0.9532 | 0.3283 | 154 | 0.1205 | 0.0368 | 168 | 0.0691 | 0.0194 | 221 | 0.082 | 0.0434 |
| FUNZEB | 11 | 0.0048 | 0.0025 | 32 | 0.0295 | 0.0173 | | | | | | | | | | 4 | 0.0021 | 0.0014 |
| GAMAFF | 32 | 0.0258 | 0.0099 | 154 | 0.1584 | 0.0618 | 45 | 0.0463 | 0.0437 | 4 | 0.0058 | 0.0038 | 1 | 0.0004 | 0.0004 | 80 | 0.0236 | 0.0088 |
| GILROB | | | | | | | | | | | | | | | | | | |
| ICTPUN | 79 | 0.0551 | 0.0139 | 116 | 0.0991 | 0.0278 | 114 | 0.2099 | 0.1086 | 42 | 0.0193 | 0.0053 | 225 | 0.0935 | 0.0163 | 110 | 0.0387 | 0.0119 |
| LEPCYA | | | | 1 | 0.0007 | 0.0007 | | | | | | | | | | | | |
| MICSAL | 1 | 0.0016 | 0.0016 | 6 | 0.0037 | 0.002 | | | | | | | | | | 10 | 0.0073 | 0.0052 |
| PIMPRO | 325 | 0.2417 | 0.093 | 2239 | 1.88 | 0.7865 | 106 | 0.1218 | 0.0502 | 27 | 0.0347 | 0.0233 | 4 | 0.0017 | 0.0017 | 117 | 0.0383 | 0.0183 |
| PTYLUC | | | | 4 | 0.0046 | 0.0023 | 1 | 0.0005 | 0.0005 | 2 | 0.0011 | 0.0008 | 15 | 0.0083 | 0.0027 | 6 | 0.0013 | 0.0006 |
| RHIOSC | 238 | 0.2454 | 0.06121 | 1364 | 7976 | 0.1667 | 172 | 0.2013 | 0.0507 | 251 | 0.2131 | 0.041 | 821 | 0.4256 | 0.1042 | 1017 | 0.5288 | 0.1178 |
| XYRTEX | | | | | | | | | | | | | | | | | | |
| Total N | 2464 | | | 11109 | | | 1400 | | | 607 | | | 1334 | | | 1858 | | |
| Area | 1438 | | | 1789 | | | 1009 | | | 1679 | | | 2525 | | | 2619 | | |
| Density | 1.71 | | | 6.21 | | | 1.38 | | | 0.36 | | | 0.53 | | | 0.71 | | |

| | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE | N | CPUE | SE |
| AMEMEL | 1 | 0.0009 | 0.0009 | | | | 9 | 0.0024 | 0.0017 | 1 | 0.0004 | 0.0004 | | | | | | |
| AMENAT | 5 | 0.0023 | 0.0016 | | | | | | | 3 | 0.0008 | 0.0005 | | | | 2 | 0.0007 | 0.0005 |
| CATDIS | 100 | 0.0367 | 0.0098 | 173 | 0.0517 | 0.017 | 218 | 0.0327 | 0.0162 | 47 | 0.0132 | 0.0034 | 36 | 0.0133 | 0.0088 | 18 | 0.0156 | 0.0060 |
| CATLAT | 78 | 0.029 | 0.0091 | 281 | 0.1341 | 0.0496 | 66 | 0.0105 | 0.0023 | 204 | 0.0551 | 0.0219 | 147 | 0.0492 | 0.0219 | 71 | 0.0244 | 0.0080 |
| CYPCAR | 4 | 0.0018 | 0.0009 | | | | | | | | | | 1 | 0.0004 | 0.0004 | | 0.0010 | 0.0010 |
| CYPLUT | 1869 | 1.0995 | 0.3286 | 378 | 0.1102 | 0.0668 | 194 | 0.0362 | 0.0136 | 36 | 0.0887 | 0.0223 | 43 | 0.0159 | 0.0049 | 24 | 0.0056 | 0.0025 |
| FUNZEB | | | | 1 | 0.0004 | 0.0004 | 16 | 0.0022 | 0.0022 | 2 | 0.0005 | 0.0004 | | | | | 0.0001 | 0.0002 |
| GAMAFF | 27 | 0.0148 | 0.0068 | 28 | 0.013 | 0.0082 | 221 | 0.0321 | 0.0275 | 229 | 0.0939 | 0.0521 | 12 | 0.0045 | 0.0019 | 3 | 0.0008 | 0.0004 |
| GILROB | | | | | | | 1 | 0.0007 | 0.0007 | 1 | 0.0002 | 0.0002 | | | | 2 | 0.0004 | 0.0004 |
| ICTPUN | 141 | 0.0823 | 0.0632 | 116 | 0.0449 | 0.0096 | 168 | 0.0383 | 0.0089 | 14 | 0.0035 | 0.0013 | 239 | 0.0652 | 0.0169 | 101 | 0.0071 | 0.0021 |
| LEPCYA | 2 | 0.0006 | 0.0006 | | | | 3 | 0.0004 | 0.0002 | 2 | 0.0012 | 0.0012 | | | | | | |
| MICSAL | 6 | 0.0042 | 0.0023 | 2 | 0.0002 | 0.0002 | 6 | 0.0010 | 0.0006 | 6 | 0.0018 | 0.0014 | | | | | 0.0010 | 0.0001 |
| PIMPRO | 18 | 0.0109 | 0.0057 | 50 | 0.0294 | 0.0183 | 22 | 0.0030 | 0.0025 | 75 | 0.0273 | 0.0131 | 4 | 0.0013 | 0.0009 | 3 | 0.0052 | 0.0021 |
| PTYLUC | 1 | 0.0004 | 0.0004 | 18 | 0.0065 | 0.0019 | 22 | 0.0020 | 0.0007 | 2 | 0.0004 | 0.0003 | 6 | 0.0018 | 0.0007 | 9 | 0.0019 | 0.0008 |
| RHIOSC | 1073 | 0.5093 | 0.118 | 886 | 0.3724 | 0.096 | 553 | 0.0918 | 0.0185 | 225 | 0.0607 | 0.0120 | 649 | 0.2002 | 0.0406 | 257 | 0.1145 | 0.0340 |
| XYRTEX | | | | | | | | | | | | | 1 | 0.0004 | 0.0004 | | | |
| Total N | 3325 | | | 1933 | | | 1499 | | | 1147 | | | 1138 | | | 490 | | |
| Area | 2387 | | | 2760 | | | 2424 | | | 3888 | | | 3171 | | | 4242 | | |
| Density | 1.39 | | | 0.70 | | | 0.76 | | | 0.30 | | | 0.36 | | | 0.12 | | |

Appendix IV. Number, mean CPUE (fish/$m^2$), and SE of fishes collected in backwater samples during small-bodied fish monitoring in the San Juan River, 2003 – 2014.

| | 2003 | | | 2004 | | | 2005 | | | 2006 | | | 2007 | | | 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* |
| AMEMEL | 12 | 0.0472 | 0.0445 | | | | | | | | | | | | | | | |
| AMENAT | | | | | | | | | | | | | 1 | 0.0036 | 0.0036 | | | |
| CATDIS | 3 | 0.0431 | 0.0276 | 2 | 0.0081 | 0.0022 | 69 | 0.1346 | 0.0265 | | | | 1 | 0.001 | 0.0002 | 6 | 0.0126 | 0.0011 |
| CATLAT | 6 | 0.0431 | 0.0276 | 1 | 0.0038 | 0.001 | 114 | 0.1556 | 0.0207 | | | | 4 | 0.0049 | 0.0005 | 26 | 0.0654 | 0.0071 |
| CYPLUT | 301 | 1.7454 | 0.4953 | 1033 | 3.6789 | 0.1984 | 566 | 1.2821 | 0.2102 | 3 | 0.0725 | 0.0513 | 67 | 0.0845 | 0.0054 | 288 | 0.5588 | 0.1032 |
| CYPCAR | | | | 3 | 0.0102 | 0.002 | 1 | 0.0053 | 0.0012 | | | | 1 | 0.0032 | 0.0005 | 2 | 0.0051 | 0.0008 |
| FUNZEB | 1 | 0.0043 | 0.0043 | 24 | 0.0603 | 0.0098 | 3 | 0.0034 | 0.0008 | | | | | | | 1 | 0.0033 | 0.0033 |
| GAMAFF | 20 | 0.1342 | 0.0812 | 17 | 0.0583 | 0.0059 | 26 | 0.0499 | 0.0077 | | | | | | | 23 | 0.0156 | 0.01 |
| ICTPUN | 10 | 0.0373 | 0.0305 | 10 | 0.0411 | 0.005 | 1 | 0.0022 | 0.0005 | | | | 64 | 0.0991 | 0.0061 | 36 | 0.0773 | 0.0078 |
| LEPCYA | 1 | 0.0108 | 0.0108 | | | | | | | | | | | | | 1 | 0.003 | 0.003 |
| MICSAL | | | | | | | 2 | 0.0132 | 0.003 | | | | | | | 6 | 0.0154 | 0.0111 |
| PIMPRO | 241 | 2.4151 | 1.3993 | 319 | 1.0457 | 0.0721 | 122 | 0.2182 | 0.0163 | 2 | 0.0394 | 0.0063 | 12 | 0.0129 | 0.0015 | 35 | 0.1122 | 0.0691 |
| PTYLUC | | | | | | | | | | | | | 21 | 0.028 | 0.0024 | 1 | 0.0026 | 0.0026 |
| RHIOSC | 4 | 0.0182 | 0.0094 | 10 | 0.0345 | 0.0164 | 12 | 0.0179 | 0.011 | 1 | 0.0242 | 0.0242 | 30 | 0.0407 | 0.0159 | 116 | 0.2098 | 0.1114 |
| Total N | 490 | | | 1415 | | | 876 | | | 6 | | | 198 | | | 541 | | |
| Area | 245 | | | 274 | | | 489 | | | 53 | | | 723 | | | 486 | | |
| Density | 2 | | | 5.16 | | | 1.79 | | | 0.11 | | | 0.27 | | | 1.11 | | |

| | 2009 | | | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Species* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* | *N* | *CPUE* | *SE* |
| AMEMEL | 121 | 0.0822 | 0.0811 | 8 | 0.012 | 0.0084 | 6 | 0.0018 | 0.0015 | | | | | | | | | |
| AMENAT | 1 | 0.0011 | 0.0011 | 1 | 0.001 | 0.001 | 1 | | | | | | | | | | | |
| CATDIS | 20 | 0.0178 | 0.0113 | | | | 1152 | 0.1703 | 0.1340 | 13 | 0.0272 | 0.0247 | 17 | 0.0409 | 0.0409 | 35 | 0.0556 | 0.0498 |
| CATLAT | 39 | 0.043 | 0.0161 | 55 | 0.0644 | 0.0311 | 15 | 0.0016 | 0.0008 | 1 | 0.0024 | 0.0024 | 91 | 0.2163 | 0.2016 | 15 | 0.0286 | 0.0147 |
| CYPLUT | 2081 | 1.799 | 0.5392 | 199 | 0.2203 | 0.0965 | 742 | 0.2368 | 0.1578 | 218 | 0.3192 | 0.2745 | 6 | 0.0119 | 0.0082 | 99 | 0.3586 | 0.3566 |
| CYPCAR | 3 | 0.0029 | 0.0017 | 1 | 0.0023 | 0.0023 | | | | | | | | | | | | |
| FUNZEB | | | | 3 | 0.0065 | 0.0057 | 11 | 0.0013 | 0.0009 | 15 | 0.0202 | 0.0137 | 4 | 0.0125 | 0.0078 | 2 | 0.0026 | 0.0026 |
| GAMAFF | 440 | 0.3973 | 0.3173 | 24 | 0.0205 | 0.0166 | 163 | 0.0352 | 0.0178 | 460 | 1.0394 | 0.4994 | 16 | 0.0784 | 0.0725 | 25 | 0.0524 | 0.0335 |
| ICTPUN | 7 | 0.0071 | 0.0041 | 11 | 0.0104 | 0.0059 | 19 | 0.0029 | 0.0019 | | | | | | | 1 | 0.0036 | 0.0036 |
| LEPCYA | 89 | 0.0741 | 0.0737 | | | | 1 | 0.0001 | 0.0001 | 9 | 0.0139 | 0.0139 | | | | | | |
| MICSAL | 21 | 0.0188 | 0.015 | | | | | | | | | | | | | | | |
| PIMPRO | 182 | 0.1317 | 0.0614 | 24 | 0.041 | 0.0289 | 88 | 0.0100 | 0.0087 | 146 | 0.2380 | 0.1653 | 185 | 0.4449 | 0.4449 | 62 | 0.1056 | 0.0833 |
| PTYLUC | 1 | 0.0006 | 0.0006 | 3 | 0.0061 | 0.0037 | 2 | 0.0002 | 0.0002 | | | | | | | | | |
| RHIOSC | 39 | 0.0416 | 0.0141 | 19 | 0.0391 | 0.0292 | 96 | 0.0075 | 0.0029 | 11 | 0.0223 | 0.0073 | 57 | 0.1614 | 0.0955 | 30 | 0.0411 | 0.0267 |
| Total N | 3044 | | | 348 | | | 2296 | | | 873 | | | 376 | | | 269 | | |
| Area | 1021 | | | 728 | | | 1235 | | | 698 | | | 347.38 | | | 786 | | |
| Density | 2.98 | | | 0.48 | | | 0.47 | | | 1.25 | | | 1.08 | | | 0.34 | | |

Appendix VI. Summary Colorado Pikeminnow captures in the San Juan River during small-bodied fish monitoring, 1998 – 2014. Note that Reaches 1 and 2 were not sampled between 2011 and 2014.

| | | *Reach* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Year* | *Length Category* | *6* | *5* | *4* | *3* | *2* | *1* | *Grand Total* |
| 1998 | N/A | | 2 | 2 | 2 | | | 6 |
| 1999 | 40 | | | 1 | | | | 4 |
| | 50 | | | | | | | |
| | 60 | | | | | | | |
| | 70 | | | | | | | |
| | 80 | | | | | | | |
| | 90 | | | | 1 | | | |
| | 100 | | | | | | | |
| | 110 | | | | | | | |
| | 120 | | 1 | | | | | |
| | 130 | | | | | | | |
| | 140 | | | | | | | |
| | 150 | | | | | | | |
| | 160 | | | | | | | |
| | 170 | | | | | | | |
| | 180 | | | | | | | |
| | 190 | | | | | | | |
| | 200 | | | | | | | |
| | 210 | | | | | | | |
| | 220 | | 1 | | | | | |
| 2000 | | | | | | | | 0 |
| 2001 | N/A | | | | | | | 0 |
| 2002 | N/A | | | | | | | 0 |
| 2003 | N/A | | | | | | | 0 |
| 2004 | 160 | | 2 | | | | | 8 |
| | 170 | | | 1 | | | | |
| | 180 | | 2 | | | | | |
| | 200 | | 1 | | | | | |
| | 210 | | 1 | | | | | |
| | 230 | | | 1 | | | | |
| 2005 | 170 | | | | 1 | | | 3 |
| | 180 | | | 1 | | | | |
| | 290 | | | | | 1 | | |
| 2006 | 140 | 1 | 1 | | | | | 10 |

| Year | Length Category | Reach 6 | 5 | 4 | 3 | 2 | 1 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| | 150 | 1 | 1 | | | | | |
| | 180 | | 1 | | 1 | | | |
| | 190 | | | | | 1 | | |
| | 200 | 1 | | | | | | |
| | 210 | | | | 1 | | | |
| | 280 | | | | 1 | | | |
| 2007 | 40 | | | | 6 | 3 | | 60 (*29 recently stocked YOY) |
| | 50 | | | | 17 | 2 | 1 | |
| | 110 | 1 | | | | | | |
| | 120 | 1 | | | | | | |
| | 130 | | 1 | | | | | |
| | 140 | 1 | 4 | | | | | |
| | 150 | 2 | 6 | | 2 | | | |
| | 160 | 2 | | 1 | 1 | | 1 | |
| | 170 | 1 | 1 | 3 | 1 | | | |
| | 180 | | 1 | | 1 | | | |
| 2008 | 130 | | 1 | | | | | 10 |
| | 140 | 1 | 1 | 1 | | | | |
| | 150 | | 2 | 1 | 1 | | | |
| | 170 | | 1 | | | | | |
| | 210 | | | | 1 | | | |
| 2009 | 130 | 1 | | | | | 1 | 12 |
| | 170 | | 1 | 1 | | 1 | | |
| | 180 | 1 | | 1 | | | | |
| | 190 | | | 1 | | | | |
| | 200 | | | 2 | | | | |
| | 210 | | | | 1 | | | |
| | 330 | | 1 | | | | | |
| 2010 | 120 | | 1 | | | | | 49 |
| | 130 | 2 | 1 | 1 | | | | |
| | 140 | 2 | 2 | 1 | 3 | | | |
| | 150 | 1 | 3 | 4 | 1 | | | |
| | 160 | | 2 | | 2 | 1 | | |
| | 170 | | 3 | 2 | 1 | | | |
| 2010 Cont'd | 180 | | 2 | | 1 | 1 | | |
| | 190 | | | 1 | 3 | 1 | | |
| | 200 | | 2 | | 1 | | | |
| | 210 | | | | 1 | | | |

| Year | Length Category | Reach 6 | 5 | 4 | 3 | 2 | 1 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| | 220 | | | | | | | |
| | 230 | | | | 1 | | | |
| | 240 | | | | | | | |
| | 250 | | | 1 | | | | |
| | 260 | | | | 1 | | | |
| 2011 | 100 | 2 | 1 | | | | | 62 |
| | 110 | 4 | 5 | | | | | |
| | 120 | 3 | 10 | | | | | |
| | 130 | 5 | 2 | 2 | | | | |
| | 140 | 2 | 7 | 1 | | | | |
| | 150 | | 5 | 1 | 1 | | | |
| | 160 | | 2 | 1 | | | | |
| | 170 | | | | | | | |
| | 180 | | | 2 | | | | |
| | 190 | | | | | | | |
| | 200 | | | | | | | |
| | 210 | | | | | | | |
| | 220 | | | | | | | |
| | 230 | | 1 | | | | | |
| | 240 | 1 | | 1 | | | | |
| | 250 | | | | | | | |
| | 260 | | | | | | | |
| | 270 | | | | 1 | | | |
| | 280 | | | | | | | |
| | 290 | | | | | | | |
| | 300 | | | | 1 | | | |
| | 360 | | 1 | | | | | |
| 2012 | 100 | | | | | | | 26 |
| | 110 | 1 | | | | | | |
| | 120 | 3 | 1 | | | | | |
| | 130 | | | | | | | |
| | 140 | 1 | 3 | 1 | 1 | | | |
| | 150 | 3 | | | | | | |
| | 160 | 2 | 1 | | 1 | | | |
| | 170 | 1 | | | 1 | | | |
| | 180 | | | | | | | |
| | 190 | 2 | 1 | 1 | 2 | | | |
| | 200 | 1 | | 1 | 1 | | | |

| Year | Length Category | Reach 6 | 5 | 4 | 3 | 2 | 1 | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 2013 | 140 | 1 | | | | | | **16 (one fish in Reach 4 not measured)** |
| | 150 | | | | | | | |
| | 160 | | | | | | | |
| | 170 | | | 1 | | | | |
| | 180 | | | | | | | |
| | 190 | | | 1 | 1 | | | |
| | 200 | | | 1 | 1 | | | |
| | 210 | | 2 | 3 | 1 | | | |
| | 220 | | | | | | | |
| | 230 | | | | | | | |
| | 240 | | | | | | | |
| | 250 | | | | | | | |
| | 260 | | | 1 | | | | |
| | 270 | | | | | | | |
| | 280 | | | | 1 | | | |
| | 290 | | | 1 | | | | |
| 2014 | 90 | 1 | | | | | | **28 (one fish in Reach 5 and one fish in Reach 6 not measured** |
| | 100 | 1 | | | | | | |
| | 110 | 2 | 2 | | | | | |
| | 120 | 1 | 3 | | | | | |
| | 130 | 3 | 2 | | | | | |
| | 140 | 4 | 3 | | 1 | | | |
| | 150 | | | | | | | |
| | 160 | | | 1 | 2 | | | |
| **Reach Totals** | | **64** | **102** | **47** | **69** | **10** | **3** | |

Appendix VII. Species, number and CPUE (fish/m2) of fishes captured during small-bodied fish monitoring at each RERI sites, 2012 – 2014.

| Year | Site (RM) | Species | Number Captured | CPUE | Comments |
|---|---|---|---|---|---|
| 2012 | 127.2 | Yellow Bullhead | 1 | 0.0073432 | |
| | | Bluehead Sucker | 8 | 0.0587458 | |
| | | Flannelmouth Sucker | 14 | 0.1028051 | |
| | | Red Shiner | 9 | 0.066089 | |
| | | Mosquito Fish | 2 | 0.0146864 | |
| | | Channel Catfish | 3 | 0.0220297 | |
| | | Fathead Minnow | 3 | 0.0220297 | |
| | | Speckled Dace | 14 | 0.1028051 | |
| | 130.7A | Bluehead Sucker | 2 | 0.0268962 | |
| | | Flannelmouth Sucker | 2 | 0.0268962 | |
| | | Red Shiner | 7 | 0.0941366 | |
| | | Mosquito Fish | 3 | 0.0403443 | |
| | | Speckled Dace | 4 | 0.0537924 | |
| | 130.7B | Bluehead Sucker | 2 | 0.0210926 | |
| | | Red Shiner | 1 | 0.0105463 | |
| | | Colorado Pikeminnow | 1 | 0.0105463 | |
| | | Speckled Dace | 8 | 0.0843704 | |
| | 132 | Red Shiner | 2 | 0.0133298 | |
| | | Colorado Pikeminnow | 1 | 0.0066649 | |
| | | Speckled Dace | 2 | 0.0133298 | |
| 2013 | 127.2 | Flannelmouth Sucker | 3 | 0.0228033 | |
| | | Red Shiner | 4 | 0.0304044 | |
| | | Channel Catfish | 2 | 0.0152022 | |
| | | Speckled Dace | 3 | 0.0228033 | |
| | 130.7A | Colorado Pikeminnow | 1 | 0.0080308 | Fast High Water |
| | | Speckled Dace | 12 | 0.0963701 | |
| | 132 | Flannelmouth Sucker | 2 | 0.0212404 | Fast High Water |
| | | Red Shiner | 1 | 0.0106202 | |
| | | Mosquito Fish | 2 | 0.0212404 | |
| | | Channel Catfish | 4 | 0.0424809 | |
| | | Speckled Dace | 12 | 0.1274427 | |
| | | Razorback Sucker | 1 | 0.0106202 | |
| | 132.2 | Red Shiner | 1 | 0.0658762 | Deep mud |
| | | Speckled Dace | 4 | 0.2635046 | |

Appendix VII continued.

| Year | Site (RM) | Species | Number Captured | CPUE | Comments |
|---|---|---|---|---|---|
| 2014 | 132.2 | Flannelmouth Sucker | 2 | 0.0061136 | |
| | | Red Shiner | 30 | 0.0917039 | |
| | | Mosquito Fish | 2 | 0.0061136 | |
| | | Colorado Pikeminnow | 2 | 0.0061136 | |
| | | Speckled Dace | 4 | 0.0122227 | |
| | 130.7B | No Fish Captured | | | |